

## **REMARKS**

### **Amendments**

No amendments are presented in this Reply. A copy of the pending claims is provided above for the Examiner's convenience.

### **Oath or Declaration**

Enclosed herewith is an English language Declaration that is in compliance with 37 CFR 1.67(a).

### **Rejections under 35 USC 103(a)**

Claims 1-4, 11-19 stand rejected as being obvious under 35 USC 103(a) in view of Heckner et al. (i.e., Kraft et al., WO 0240578) and Papenfuhs et al. (WO 03/020776; US 7,358,304).

The rejection based on the disclosures of Heckner et al. (Kraft et al., WO 0240578) and Papenfuhs et al. (WO 03/020776; US 7,358,304) is discussed and traversed in the Reply filed November 22, 2010, the comments/arguments of which are incorporated herein.

To further demonstrate the non-obvious character of the claimed invention, submitted herewith is a Rule 132 Declaration by one of the co-inventors, Alexander Kraft. This Declaration presents comparative test demonstrating the unexpected results associated with the claimed invention.

In Comparative Example I of the Declaration, an ion-conductive PVB film or foil was prepared in accordance with Comparative Example 1 of applicants' specification (see page 9 of the specification). The PVB film was prepared from 65 % by weight of PVB (77.5 % by weight polyvinyl butyral content, a 20.5 % PVOH content, and a 2 % polyvinyl acetate content) and 35 % by weight of the plasticizer (tetraethylene glycol dimethyl ether). The plasticizer contained lithium trifluoromethane sulphonate as support electrolyte (7.33 % by weight) and UV absorber Tinuvin 571 (0.15 mass %). The resultant film was used to manufacture an electrochromic element, wherein a K-glass pane (FTO-coated float glass), coated electrochemically with tungsten trioxide and a second K-glass pane coated with Prussian blue were laminated together with using the prepared ion-conductive PVB film.

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This electrochromic element had an active switchable surface of 7.5 cm x 18.5 cm (213.75 cm<sup>2</sup>). The ion conductivity of the film in the finished element, determined from the impedance at 40 kHz, was  $3.3 \cdot 10^{-6}$  S/cm. Also, in this Example, during switching, a strong decrease in switching capacity was observed.

In Comparative Example II, the procedure of Comparative Example I was repeated, except that the ion-conductive PVB film was prepared with the following composition: 65 % by weight of PVB (65.8 % by weight polyvinyl butyral content, a 32.2 % PVOH content, and a 2 % polyvinyl acetate content), and 35 % by weight of the plasticizer (TGEDME). The plasticizer contained lithium trifluoromethane sulphonate as support electrolyte (7.33 % by weight). This electrochromic element had an active switchable surface of 7.5 cm x 18.5 cm (213.75 cm<sup>2</sup>). The ion conductivity of the film in the finished element, determined from the impedance at 40 kHz, was  $3.37 \cdot 10^{-6}$  S/cm was. Also, in this Example, during switching, delamination was observed.

As can be seen, the above described Comparative Examples do not contain a partially acetalated polyvinyl alcohol co-polymer in accordance with the claimed invention.

The Declaration further presents seven Examples in accordance with the invention (referred to as Practical Examples). Practical Example 1 corresponds to Example II in applicants' specification (see page 10 of the specification). The PVB film was prepared from 65 % by weight of PVB (77.5 % by weight polyvinyl butyral content, a 20.2 % PVOH content, a 1.8 % polyvinyl acetate content, and an acetal of glyoxylic acid content of 0.5 %), and 35 % by weight of the plasticizer (tetraethylene glycol dimethyl ether). The plasticizer contained lithium trifluoromethane sulphonate as support electrolyte (7.33 % by weight) and UV absorber Tinuvin 571 (0.15 mass %).

The resultant film was used to manufacture an electrochromic element, as described in Comparative Example I. This electrochromic element had an active switchable surface of 9 cm x 30 cm (270 cm<sup>2</sup>). The ion conductivity of the film in the finished element, determined from the impedance at 40 kHz, was  $6.9 \cdot 10^{-6}$  S/cm. Thus, in comparison to Comparative Example I, the incorporation of the glyoxylic acid group into the polymer chain of the PVB consequently lead to a more than 100% increase in the ion conductivity. No decrease in switching capacity or delamination was observed.

In Practical Example 2, the procedure of Practical Example 1 was repeated, except

that the ion-conductive PVB film was prepared with the following composition: 65 % by weight of PVB (78 % by weight polyvinyl butyral content, a 18 % PVOH content, a 2 % polyvinyl acetate content, and an acetal of glyoxylic acid content of 2 %), and 35 % by weight of the plasticizer (tetraethylene glycol dimethyl ether). The plasticizer contained lithium trifluoromethane sulphonate as support electrolyte (7.33 % by weight). The ion conductivity of the film in the finished element, determined from the impedance at 40 kHz, was  $6.9 \cdot 10^{-6}$  S/cm. Thus, in comparison to Comparative Example I, the incorporation of the glyoxylic acid group into the polymer chain of the PVB lead to a more than 100% increase in the ion conductivity. No decrease in switching capacity or delamination was observed.

In Practical Example 3, the procedure of Practical Example 1 was repeated, except that the ion-conductive PVB film was prepared with the following composition: 65 % by weight of PVB (74.3 % by weight polyvinyl butyral content, a 23.5 % PVOH content, a 2 % polyvinyl acetate content, and an acetal of glyoxylic acid content of 1 %), and 35 % by weight of the plasticizer (tetraethylene glycol dimethyl ether). The plasticizer contained lithium trifluoromethane sulphonate as support electrolyte (7.33 % by weight). The ion conductivity of the film in the finished element, determined from the impedance at 40 kHz, was  $6.8 \cdot 10^{-6}$  S/cm. No decrease in switching capacity or delamination was observed.

In Practical Example 4, the procedure of Practical Example 1 was repeated, except that the ion-conductive PVB film was prepared with the following composition: 68 % by weight of PVB (77.7 % by weight polyvinyl butyral content, a 20.1 % PVOH content, a 2 % polyvinyl acetate content, and an acetal of glyoxylic acid content of 0.2 %), and 32 % by weight of the plasticizer (tetraethylene glycol dimethyl ether). The plasticizer contained lithium trifluoromethane sulphonate as support electrolyte (7.33 % by weight). The ion conductivity of the film in the finished element, determined from the impedance at 40 kHz, was  $5.0 \cdot 10^{-6}$  S/cm. No decrease in switching capacity or delamination was observed.

In Practical Example 5, the procedure of Practical Example 1 was repeated, except that the ion-conductive PVB film was prepared with the following composition: 65 % by weight of PVB (77.7 % by weight polyvinyl butyral content, a 20.1 % PVOH content, a 2 % polyvinyl acetate content, and an acetal of glyoxylic acid content of 0.2 %), 30 % by weight of tetraethylene glycol dimethyl ether plasticizer, which plasticizer contained lithium trifluoromethane sulphonate as support electrolyte (7.33 % by weight), and 5 % by weight of

triethylene glycol diheptanoate plasticizer. The ion conductivity of the film in the finished element, determined from the impedance at 40 kHz, was  $4.8 \cdot 10^{-6}$  S/cm. No decrease in switching capacity or delamination was observed.

In Practical Example 6, the procedure of Practical Example 1 was repeated, except that the ion-conductive PVB film was prepared with the following composition: 65 % by weight of PVB (77.7 % by weight polyvinyl butyral content, a 20.1 % PVOH content, a 2 % polyvinyl acetate content, and an acetal of glyoxylic acid content of 0.2 %), and 35 % by weight of the plasticizer (tetraethylene glycol dimethyl ether). The plasticizer contained lithium trifluoromethane sulphonate as support electrolyte (7.33 % by weight). The ion conductivity of the film in the finished element, determined from the impedance at 40 kHz, was  $6.9 \cdot 10^{-6}$  S/cm. No decrease in switching capacity or delamination was observed.

In Practical Example 7, the procedure of Practical Example 1 was repeated, except that the ion-conductive PVB film was prepared with the following composition: 70 % by weight of PVB (77.7 % by weight polyvinyl butyral content, a 20.1 % PVOH content, a 2 % polyvinyl acetate content, and an acetal of glyoxylic acid content of 0.2 %), and 30 % by weight of the plasticizer (tetraethylene glycol dimethyl ether). The plasticizer contained lithium trifluoromethane sulphonate as support electrolyte (10 % by weight). The ion conductivity of the film in the finished element, determined from the impedance at 40 kHz, was  $6.75 \cdot 10^{-6}$  S/cm.

The tests results for Comparative Examples I-II and Practical Examples 1-7 are summarized in Tables 1-2 of the Declaration.

As stated in the Declaration, the test results demonstrate that the PVB compositions according to claimed invention result in a significant and unexpected 30-100 % increase in ion conductivity (i.e., from 4.8 to  $6.9 \cdot 10^{-6}$  S/cm) compared to the prior art compositions (i.e.,  $3.3$  to  $3.7 \cdot 10^{-6}$  S/cm). Moreover, the compositions according to the present invention have a highly stable electrochromic element resulting in a low decrease of switching capacity. In contrast, the prior art compositions had produced low stability electrochromic elements resulting in either a strong decrease of switching capacity or delamination.

In view of the above remarks, it is respectfully submitted that the disclosure of Heckner et al. (i.e., Kraft et al., WO 0240578), taken alone or in combination with the disclosure of Papenfuhs et al., fails to render obvious applicants' claimed invention.

Withdrawal of the rejection is respectfully requested.

The Commissioner is hereby authorized to charge any fees associated with this response or credit any overpayment to Deposit Account No. 13-3402.

Respectfully submitted,

/Brion P. Heaney/

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